

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
International Bureau(43) International Publication Date  
11 March 2004 (11.03.2004)

PCT

(10) International Publication Number  
**WO 2004/020338 A3**(51) International Patent Classification<sup>7</sup>: **C01G 37/02**,  
37/027, G11B 5/706, H01F 1/40(21) International Application Number:  
PCT/IN2003/000278

(22) International Filing Date: 22 August 2003 (22.08.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
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(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(88) Date of publication of the international search report:  
12 August 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **CHROMIUM DIOXIDE (CrO<sub>2</sub>) AND COMPOSITES OF CHROMIUM DIOXIDE AND OTHER OXIDES OF CHROMIUM SUCH AS CrO<sub>2</sub>/Cr<sub>2</sub>O<sub>3</sub> AND CrO<sub>2</sub>/Cr<sub>2</sub>O<sub>5</sub> AND PROCESS FOR MANUFACTURING THE SAME**(57) Abstract: A novel process for preparing chromium dioxide of substantially high purity as well as composites of CrO<sub>2</sub>/Cr<sub>2</sub>O<sub>3</sub> and CrO<sub>2</sub>/Cr<sub>2</sub>O<sub>5</sub> following a sequence of simple steps. The process does not require pressure as a control parameter during the process of synthesis. No chemical modifier has been used to bring down the working pressure during synthesis. Fairly hard sintered pellets of synthesis. CrO<sub>2</sub> can be obtained without introducing any detectable impurity phase that usually appears during the process of sintering. Further, CrO<sub>2</sub>/Cr<sub>2</sub>O<sub>3</sub> and CrO<sub>2</sub>/Cr<sub>2</sub>O<sub>5</sub> composites have also been prepared where the fraction of insulating Cr<sub>2</sub>O<sub>3</sub> or Cr<sub>2</sub>O<sub>5</sub> in metallic CrO<sub>2</sub> can be easily controlled. Significant negative magnetoresistance is found in pure CrO<sub>2</sub> (5 % MR) as well as CrO<sub>2</sub>/Cr<sub>2</sub>O<sub>3</sub> (33 % MR) composites near room temperature. The MR studies on the CrO<sub>2</sub>/Cr<sub>2</sub>O<sub>5</sub> composites have been done and significant negative MR (22 %) has been found in CrO<sub>2</sub>/Cr<sub>2</sub>O<sub>5</sub> composites near room temperature.

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# INTERNATIONAL SEARCH REPORT

national Application No  
PCT/IN 03/00278

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 C01G37/02 C01G37/027 G11B5/706 H01F1/40

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 C01G G11B H01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)  
EPO-Internal, WPI Data, PAJ, CHEM ABS Data, INSPEC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JIANBIAO DAI AND JINKE TANG: "Junktion-like magnetoresistance of intergranular tunneling in field-aligned chromium dioxide powders" PHYSICAL REVIEW B, vol. 63, no. 054434, - 12 January 2001 (2001-01-12) pages 1-4, XP002267622 cited in the application page 1, right-hand column -page 2, left-hand column	1,5
A	US 3 449 073 A (BALTHIS JOSEPH H JR) 10 June 1969 (1969-06-10) cited in the application the whole document	1-8

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*G\* document member of the same patent family

Date of the actual completion of the international search

5 May 2004

Date of mailing of the international search report

14 05 04

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International Application No  
PCT/IN 03/00278

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 1 298 581 A (DU PONT) 13 July 1962 (1962-07-13) page 3, left-hand column, paragraph 2 examples	1-8
A	US 4 126 714 A (HAINES ROBERT S) 21 November 1978 (1978-11-21) examples	1-8
X	GB 1 274 880 A (RCA CORPORATION) 17 May 1972 (1972-05-17)  page 1, line 44 -page 2, line 35 examples I,IV	9,23,25, 27, 29-32, 34,35, 37,38
X	L. RANNO ET AL.: "Production and magnetotransport properties of CrO <sub>2</sub> films" J. APPL. PHYS. , vol. 81, no. 8, 15 April 1997 (1997-04-15), pages 5774-5776, XP002278997 cited in the application page 5774, paragraph SYNTHESIS	9,16,23, 25-27, 29-32, 36-39
X	US 3 117 093 A (ARTHUR JR PAUL ET AL) 7 January 1964 (1964-01-07) cited in the application  column 2, line 48-61 examples	16,23, 25,27, 33-35, 37,39
X	GB 1 343 622 A (MONTEDISON SPA) 16 January 1974 (1974-01-16)  the whole document	25,26, 29,32, 33,37
X	US 3 979 310 A (ASPES PIERFRANCESCO ET AL) 7 September 1976 (1976-09-07) the whole document	25,32, 33,37
A	P. G. IVANOV ET AL.: "Epitaxial growth of CrO <sub>2</sub> thin films by chemical-vapour deposition from a CrO <sub>2</sub> precursor " J. APPLI. PHYS., vol. 89, no. 2, 15 January 2001 (2001-01-15), pages 1035-1040, XP002278998 the whole document	9,16,23, 25-32

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/IN 03/00278

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this International application, as follows:

see additional sheet.

As a result of the prior review under R. 40.2(e) PCT,  
part of the additional fees are to be refunded.

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☒ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-8

Chromium dioxide having saturation magnetisation of at least 110 emu/g

2. Claims: 9-15,21-24

Composite of chromium dioxide and chromium sesquioxide having negative magnetoresistance of at least 0.5% near room temperature at 2 Tesla

3. Claims: 16-24

Composite of chromium dioxide and Cr<sub>2</sub>O<sub>5</sub> having negative magnetoresistance of at least 0.5% near room temperature at 2 Tesla

4. Claims: 25-35,37

Preparation process for chromium dioxide by heating an intermediate oxide at a given temperature for 1 to 5 hours and the product obtained therefrom

5. Claims: 25-36,38

Preparation process for a composite of chromium dioxide and chromium sesquioxide by heating an intermediate oxide at a given temperature for 1 to 5 hours and the product obtained therefrom

6. Claims: 25-36,39

Preparation process for a composite of chromium dioxide and Cr<sub>2</sub>O<sub>5</sub> by heating an intermediate oxide at a given temperature for 1 to 5 hours and the product obtained therefrom

## INTERNATIONAL SEARCH REPORT

national Application No  
PCT/IN 03/00278

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